PATENT ABSTRACTS OF JAPAN

(11)Publication number : 05-222923
(43)Date of publication of application : 31.08.1993

(51)Int.Cl. F01N 3/08
B01D 53/34
B01D 53/36

(21)Application number : 04-056366
(22)Date of filing : 06.02.1992

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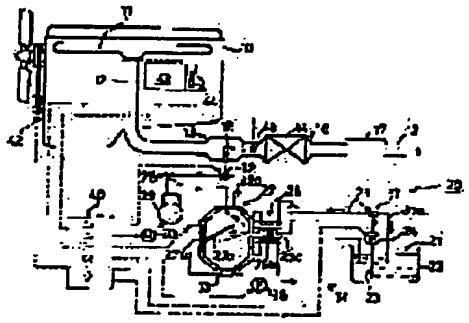
(54) NOX-IN-ENGINE-EXHAUST-GAS REDUCING DEVICE BY MEANS OF CATALYST

(57)Abstract:
PURPOSE: To supply a proper quantity of reducing agents in accordance the operating condition of an engine, even if a hydrocarbon reducing agent having a low invert ratio of NOx to N2 in respect of component constitution is used, by reforming it so as to efficiently reduce NOx.
CONSTITUTION: The exhaust pipe 12 of an engine 10 is provided with a NOx catalyst 14 and an injection nozzle 18 arranged upstream thereof. A reducing agent supply means 20 for supplying a hydrocarbon reducing agent to the injection nozzle 18 is provided with a storage tank 22 for storing liquid hydrocarbon 21, a force-feeding pump 24 for forcibly feeding the hydrocarbon 21 stored in this tank 22 through a liquid feeding pipe 23, a reactor 26 for reforming the forcibly fed hydrocarbon 21 so as to reduce the number of carbons thereof, a hydrocarbon separating chamber 27 for separating the reformed hydrocarbon from the unreformed hydrocarbon, and a compressor 29 for forcibly feeding the reformed hydrocarbon to the injection nozzle 18 through a pneumatic tube 28.



LEGAL STATUS

[Date of request for examination] 23.07.1996
[Date of sending the examiner's decision of rejection] 09.11.1999
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]
[Date of final disposal for application]
[Patent number]
[Date of registration]
[Number of appeal against examiner's decision of rejection]
[Date of requesting appeal against examiner's

decision of rejection]
[Date of extinction of right]

* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] The catalyst room in which it is prepared in an engine (10) exhaust pipe (12), and an NOx catalyst (14) is held (16), It is prepared in the exhaust gas upstream of said NOx catalyst (14), and turns to said NOx catalyst (14). The injection nozzle which can inject a hydrocarbon system reducing agent (18), In the NOx reduction equipment by the catalyst of the engine exhaust gas which equipped said injection nozzle (18) with a reducing-agent supply means (20) to supply said reducing agent The storage tank in which said reducing-agent supply means (20) stores a liquefied hydrocarbon (21) (22), The feeding pump which feeds the hydrocarbon (21) stored in said storage tank (22) through a liquid transfer pipe (23) (24), The reactor which reforms said fed hydrocarbon (21) so that the carbon number may be decreased (26), The hydrocarbon separation room which separates said hydrocarbon by which reforming was carried out, and the hydrocarbon by which reforming was not carried out (27), NOx reduction equipment by the catalyst of the engine exhaust gas characterized by having the compressor (29) which feeds said hydrocarbon by which reforming was carried out to said injection nozzle (18) through the pneumatic tube (28).
[Claim 2] The temperature sensor formed in the exhaust gas upstream of an NOx catalyst (14) (46), The load sensor (44) which detects an engine (10) load, and the rotation sensor which detects an engine (10) rotational speed (42), The 1st flow control valve (31) prepared in the liquid transfer pipe (23), and the 2nd flow control valve prepared in the pneumatic tube (28) (32), It is based on the detection output of said temperature sensor (46), a load sensor (44), and a rotation sensor (42). A feeding pump (24), A compressor (29), NOx reduction equipment by the catalyst of engine exhaust gas [equipped with the controller (40) which controls said 1st and 2nd flow control valves (31 32)] according to claim 1.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the equipment which reduces the nitrogen oxides (henceforth NOx) contained in engine exhaust gas according to a catalyst. Furthermore, it is related with the NOx reduction equipment in the exhaust gas of the engine for cars in detail.
[0002]
[Description of the Prior Art] As this kind of NOx reduction equipment, the catalyst room which holds an NOx catalyst in an engine exhaust pipe is prepared, the reducing agent of NOx is injected by the injection nozzle from the exhaust gas upstream of this NOx catalyst, and the equipment which converts NOx into harmless N2 according to a catalyst is known. Conventionally, ammonia has been used for this reducing agent.
[0003]
[Problem(s) to be Solved by the Invention] However, ammonia was unsuitable for the NOx reducing agent of the engine both for a problem empty vehicle of the odor when it having been inferior and revealing to mount nature. Moreover, when gas oil was used as a reducing agent, a carbon number could not convert NOx into N2 efficiently at this point, including the hydrocarbon component of 16 mostly, but gas oil had fault with the high rate of NOx emitted to atmospheric air as it is. Even if the purpose of this invention is a hydrocarbon system reducing agent with the low invert ratio of N2 of NOx in respect of a component presentation, it is to offer the NOx reduction equipment by the catalyst of engine exhaust gas which reforms this and can reduce NOx efficiently. Another purpose of this invention is to offer the NOx reduction equipment which can supply the reducing agent of optimum dose according to engine operational status.
[0004]
[Means for Solving the Problem] The configuration of this invention for attaining the above-mentioned purpose is explained based on drawing 1 corresponding to an example. This invention is amelioration of the NOx reduction equipment by the catalyst of engine exhaust gas equipped with the catalyst room 16 in which it is prepared in the exhaust pipe 12 of an engine 10, and the NOx catalyst 14 is held, and a reducing-agent supply means 20 to be formed in the exhaust gas upstream of the NOx catalyst 14, and to supply said reducing agent to the injection nozzle 18 which can inject a hydrocarbon system reducing agent, and an injection nozzle 18 towards this NOx catalyst 14. The storage tank 22 in which, as for the characteristic configuration, the reducing-agent supply means 20 stores the liquefied hydrocarbon 21, The feeding pump 24 which feeds the hydrocarbon 21 stored in this tank 22 through a liquid transfer pipe 23, The reactor 26 which reforms this fed hydrocarbon 21 so that that carbon number may be decreased, It is in having had the hydrocarbon separation room 27 which separates the hydrocarbon by which reforming was carried out, and the hydrocarbon by which reforming was not carried out, and the compressor 29 which feeds the hydrocarbon by which reforming was carried out to an injection nozzle 18 through the pneumatic tube 28. In addition, the temperature sensor 46 formed in this NOx reduction equipment at the exhaust gas upstream of the NOx catalyst 14, The load sensor 44 which detects the load of an engine 10, and the rotation sensor 42 which detects the rotational speed of an engine 10, The 1st flow control valve 31 prepared in the liquid transfer pipe 23, and the 2nd flow control valve 32 prepared in the pneumatic tube 28, It is desirable to have the feeding pump 24, a compressor 29, and the controller 40 that controls the 1st

and 2nd flow control valves 31 and 32 based on the detection output of a temperature sensor 46, the load sensor 44, and the rotation sensor 42. Furthermore, it is desirable to form the recovery tank 33 which collects the liquefied hydrocarbons by which reforming was not carried out to the pars basilaris ossis occipitalis of the hydrocarbon separation room 27 of this NOx reduction equipment, and to form the recovery pump 36 which returns the liquefied hydrocarbon of this recovery tank 33 to a storage tank 22.

[0005]

[Function] The gas discharged from the engine 10 passes along an exhaust pipe 12, and it flows into the catalyst room 16 with the reducing agent supplied from the injection nozzle 18, and after reduction processing of NOx in exhaust gas being carried out by the NOx catalyst 14 there and converting into harmless N2, it is emitted to atmospheric air. Qualitatively, since the reducing agent supplied from an injection nozzle 18 is the hydrocarbon of low molecular weight with which the carbon number by which cracking was carried out by the reactor 26 and purification separation was carried out at the separation room 27 decreased, it converts NOx into N2 at high effectiveness. Moreover, quantitatively, a controller 40 controls a flow control valve 31 and 32 grades, and supplies the reducing agent of the optimum dose corresponding to the NOx content in the exhaust gas memorized according to operational status from an injection nozzle 18.

[0006]

[Example] Next, one example of this invention is explained in detail based on a drawing. As shown in drawing 1 , an exhaust pipe 12 is connected to the exhaust manifold 11 of a diesel power plant 10. In the middle of this exhaust pipe 12, an engine side to the reducing-agent injection room 13, the catalyst room 16 in which the NOx catalyst 14 is held, and a muffler 17 are formed in this order. The NOx catalyst 14 is constituted from this example by the copper ion exchange zeolite (Cu-ZSM -5). This copper ion exchange zeolite is the matter which transposed the sodium ion which the zeolite contains to the copper ion, and has the property to return NOx with a hydrocarbon. An injection nozzle 18 is formed in the reducing-agent injection room 13 towards the NOx catalyst 14.

[0007] A reducing-agent supply means 20 to supply a hydrocarbon system reducing agent to an injection nozzle 18 The storage tank 22 in which gas oil 21 is stored, and the feeding pump 24 which feeds this gas oil 21 through a liquid transfer pipe 23, It is constituted by the hydrocarbon separation room 27 which separates the reactor 26 reformed so that the carbon number of the fed gas oil may be decreased, and the hydrocarbon by which reforming was carried out and the hydrocarbon by which reforming was not carried out, and the compressor 29 which feeds the hydrocarbon by which reforming was carried out to an injection nozzle 18 through the pneumatic tube 28. In this example, a compressor 29 is driven by the motor 30. The 1st flow control valve 31 is formed in the liquid transfer pipe 23 of the discharge side of a pump 24, and the 2nd flow control valve 32 is formed in the pneumatic tube 28 of the discharge side of a compressor 29, respectively. These regulator valves 31 and 32 are solenoid valves, and return-pipe 31a to a tank 22 and return-pipe 32a to the hydrocarbon separation room 27 are connected to regulator valves 31 and 32, respectively.

[0008] A reactor 26 carries out cracking of the gas oil which uses as a principal component the hydrocarbon of the carbon number 16 fed from the pump 24, and reforms it mainly for the component of carbon numbers 3-10. A reactor 26 is equipped with column 26a with which the granular zeolite was filled up, and heater 26b which heats this column 26a in this example. The hydrocarbon separation room 27 equips with heater 27b separator 27a divided into the gas oil by which reforming was carried out to carbon numbers 3-10, and the other gas oil, and a perimeter. The inlet port of column 26a is connected to said liquid transfer pipe 23, and the outlet is turned to separator 27a of the hydrocarbon separation room 27. The recovery tank 33 which collects the liquefied hydrocarbons by which reforming was not carried out is formed in the pars basilaris ossis occipitalis of this separation room 27, and return-pipe 32a is connected with the pneumatic tube 28 which attracts the hydrocarbon which reforming was carried out to the crowning of the separation room 27, and was evaporated and which was mentioned above. Between this recovery tank 33 and a storage tank 22, the recovery tubing 34 is connected, and the recovery pump 36 is formed while being the recovery tubing 34.

[0009] The control output of a controller 40 is connected to the 1st and 2nd flow control valves 31 and 32, the feeding pump 24, the motor 30 for a compressor drive, Heaters 26a and 27b, and the

recovery pump 36. The rotation sensor 42 which detects the rotational speed of an engine 10, the load lever location sensor 44 of the jet pump 43 which detects an engine load, and the temperature sensor 46 which detects the exhaust-gas temperature which flows into the NOx catalyst 14 of the catalyst room 16 are connected to the control input of this controller 40. A controller 40 is equipped with the memory which is not illustrated. The amount of the hydrocarbon which should be supplied to the NOx catalyst 14 from an injection nozzle 18 according to rotational speed, an engine load, and an engine exhaust-gas temperature is beforehand memorized by this memory, and, as for a controller 40, regulator valves 31 and 32, the feeding pump 24, and the motor 30 grade for a compressor drive are controlled based on this amount of supply.

[0010] Actuation of the NOx reduction equipment of such a configuration is explained. First, the gas discharged from the engine 10 passes along an exhaust pipe 12, goes into the reducing-agent injection room 13, and receives supply of a hydrocarbon system reducing agent by the injection nozzle 18 here. The exhaust gas which received supply of this reducing agent goes into the catalyst room 16, and after carrying out reduction processing of NOx in exhaust gas with the NOx catalyst 14 and converting into harmless N2, it is emitted to atmospheric air. As for the reducing agent injected from an injection nozzle 18 here, the quality is improved by the following approach. First, it is sent to column 26a of a reactor 26 with the feeding pump 24 from a storage tank 22, and at the temperature of 400-500 degrees C, gas oil contacts a zeolite catalyst, and decomposes and evaporates to it. Reforming of the gas oil is carried out mainly to the hydrocarbon of the low molecular weight of carbon numbers 3-10 by cracking of this gas oil. The hydrocarbon of the amount of macromolecules by which reforming was not carried out by the reactor 26 is separated with the hydrocarbon by which reforming was carried out by separator 27a of the hydrocarbon separation room 27. This reforming reducing agent by which purification separation was carried out is compressed by the compressor 29, and is injected from an injection nozzle 18. The hydrocarbon system reducing agent with which this carbon number decreased converts NOx into N2 at high effectiveness in the NOx catalyst 14.

[0011] Moreover, the amount of the reducing agent injected from an injection nozzle 18 is controlled by the following approach. A controller 40 controls flow control valves 31 and 32, the feeding pump 24, and the motor 30 grade for a compressor drive for the reducing agent of the optimum dose corresponding to the NOx content in the exhaust gas memorized by memory according to operational status with the detection output of sensors 42, 44, and 46 according to the amount of read-out and this reducing agent, and supplies the reducing agent of optimum dose from an injection nozzle 18. Specifically, a controller 40 is controlled so that an engine 10 extracts the injection quantity by the low rpm at the time of a light load and increases the injection quantity by the inside high rpm at the time of an inside heavy load. Furthermore, the hydrocarbon system reducing agents of the high-boiling point by which reforming was not carried out at the hydrocarbon separation room 27 are collected by the recovery tank 33, and are returned to a storage tank 22 with the recovery pump 36. In addition, although the copper ion exchange zeolite was mentioned as an NOx catalyst in the above-mentioned example, the catalyst of other zeolite systems and an oxide system is sufficient. Moreover, although the example which cracks gas oil catalytically using a zeolite catalyst in a reactor was shown, other catalysts, such as titanium oxide and a silica-alumina catalyst, may be used.

[0012]

[Effect of the Invention] In order to reform by the reactor even if it is gas oil which contains the hydrocarbon of a high-boiling point with the low invert ratio of N2 of NOx in respect of a component presentation of a hydrocarbon system reducing agent according to [as stated above] this invention, to carry out purification separation at a hydrocarbon separation room and to inject an effective hydrocarbon system reducing agent from a drawing injection nozzle alternatively, on an NOx catalyst, NOx in exhaust gas is efficient and it converts into N2. Moreover, since the injection quantity of a reducing agent is controlled according to engine operational status and the reducing agent of optimum dose is supplied according to NOx in exhaust gas as a result, NOx contained in exhaust gas can be reduced effectively.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The block diagram of the NOx reduction equipment of one example of this invention.
[Description of Notations]
10 Engine
12 Exhaust Pipe
13 Reducing-Agent Injection Room
14 NOx Catalyst
16 Catalyst Room
18 Injection Nozzle
20 Reducing-Agent Supply Means
21 Gas Oil (Hydrocarbon System Reducing Agent)
22 Storage Tank
23 Liquid Transfer Pipe
24 Feeding Pump
26 Reactor
27 Hydrocarbon Separation Room
28 Pneumatic Tube
29 Compressor
31 1st Flow Control Valve
32 2nd Flow Control Valve
33 Recovery Tank
36 Recovery Pump
40 Controller
42 Rotation Sensor
44 Load Sensor
46 Temperature Sensor

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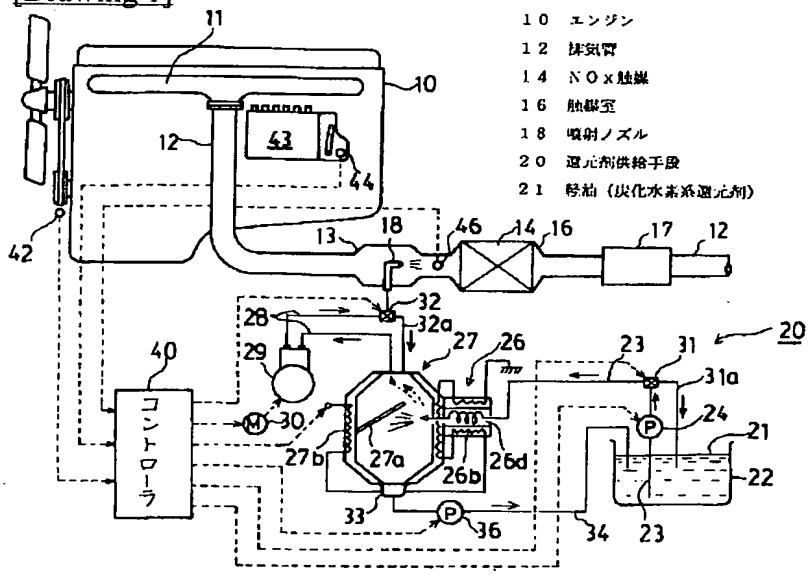
DRAWINGS

[Drawing 1]



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(19)日本国特許庁（ＪＰ）　(12)公開特許公報（Ａ）　(11)特許出願公開番号

特開平5－222923

(43)公開日　平成５年(1993)８月31日

(51)Int.Cl.[5]		識別記号	庁内整理番号	ＦＩ	技術表示箇所
Ｆ０１Ｎ	3/08	Ｂ	7910－3Ｇ		
Ｂ０１Ｄ	53/34	１２９　Ｅ	6953－4Ｄ		
	53/36	１０１　Ａ	9042－4Ｄ		

審査請求　未請求　請求項の数２(全　４　頁)

(21)出願番号　特願平4－56366

(22)出願日　平成４年(1992)２月６日

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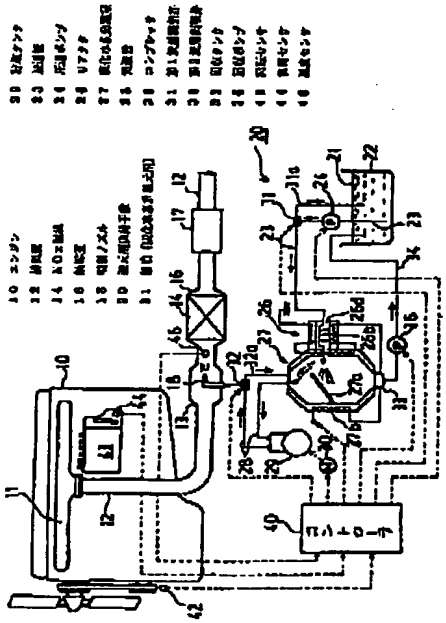
(54)【発明の名称】　エンジン排ガスの触媒によるＮＯｘ低減装置

(57)【要約】
【目的】　成分組成の点でＮＯｘのＮ₂への転化率が低い炭化水素系還元剤であってもこれを改質して効率良くＮＯｘを低減する。またエンジンの運転状態に応じて適量の還元剤を供給する。
【構成】　エンジン１０の排気管１２にＮＯｘ触媒１４とその排ガス上流側に噴射ノズル１８が設けられる。この噴射ノズル１８に炭化水素系還元剤を供給する還元剤供給手段２０は、液状の炭化水素２１を貯える貯蔵タンク２２と、このタンク２２に貯えられた炭化水素２１を液送管２３を介して圧送する圧送ポンプ２４と、この圧送された炭化水素２１をその炭素数を減少するように改質するリアクタ２６と、改質された炭化水素と改質されなかった炭化水素とを分離する炭化水素分離室２７と、改質された炭化水素を気送管２８を介して噴射ノズル１８に圧送するコンプレッサ２９とを備える。



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【特許請求の範囲】

【請求項１】 エンジン(10)の排気管(12)に設けられＮＯｘ触媒(14)を収容する触媒室(16)と、

前記ＮＯｘ触媒(14)の排ガス上流側に設けられ前記ＮＯｘ触媒(14)に向けて炭化水素系還元剤を噴射可能な噴射ノズル(18)と、

前記噴射ノズル(18)に前記還元剤を供給する還元剤供給手段(20)とを備えたエンジン排ガスの触媒によるＮＯｘ低減装置において、

前記還元剤供給手段(20)が液状の炭化水素(21)を貯える貯蔵タンク(22)と、

前記貯蔵タンク(22)に貯えられた炭化水素(21)を液送管(23)を介して圧送する圧送ポンプ(24)と、

前記圧送された炭化水素(21)をその炭素数を減少するように改質するリアクタ(26)と、

前記改質された炭化水素と改質されなかった炭化水素とを分離する炭化水素分離室(27)と、

前記改質された炭化水素を気送管(28)を介して前記噴射ノズル(18)に圧送するコンプレッサ(29)とを備えたことを特徴とするエンジン排ガスの触媒によるＮＯｘ低減装置。

【請求項２】 ＮＯｘ触媒(14)の排ガス上流側に設けられた温度センサ(46)と、

エンジン(10)の負荷を検出する負荷センサ(44)と、

エンジン(10)の回転速度を検出する回転センサ(42)と、

液送管(23)に設けられた第１流量調整弁(31)と、

気送管(28)に設けられた第２流量調整弁(32)と、

前記温度センサ(46)、負荷センサ(44)及び回転センサ(42)の検出出力に基づいて圧送ポンプ(24)、コンプレッサ(29)、前記第１及び第２流量調整弁(31,32)を制御するコントローラ(40)とを備えた請求項１記載のエンジン排ガスの触媒によるＮＯｘ低減装置。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、エンジンの排ガスに含まれる窒素酸化物（以下、ＮＯｘという）を触媒により低減する装置に関する。更に詳しくは車両用エンジンの排ガス中のＮＯｘ低減装置に関するものである。

【０００２】

【従来の技術】この種のＮＯｘ低減装置として、エンジンの排気管にＮＯｘ触媒を収容する触媒室を設け、このＮＯｘ触媒の排ガス上流側より噴射ノズルでＮＯｘの還元剤を噴射して、触媒によりＮＯｘを無害なN_2に転化する装置が知られている。従来、この還元剤にはアンモニアが用いられてきた。

【０００３】

【発明が解決しようとする課題】しかし、アンモニアは毒劇性に劣り、かつ漏洩したときの臭気の問題から車両用エンジンのＮＯｘ還元剤には不向きであった。また還元剤として軽油を用いた場合には、軽油は炭素数が１６

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の炭化水素成分を多く含み、この点で効率良くＮＯｘをN_2に転化することができず、そのまま大気に放出されてしまうＮＯｘの割合が高い不具合があった。本発明の目的は、成分組成の点でＮＯｘのN_2への転化率が低い炭化水素系還元剤であってもこれを改質して効率良くＮＯｘを低減し得る、エンジン排ガスの触媒によるＮＯｘ低減装置を提供することにある。本発明の別の目的は、エンジンの運転状態に応じて適量の還元剤を供給し得るＮＯｘ低減装置を提供することにある。

【０００４】

【課題を解決するための手段】上記目的を達成するための本発明の構成を実施例に対応する図１に基づいて説明する。本発明は、エンジン１０の排気管１２に設けられＮＯｘ触媒１４を収容する触媒室１６と、ＮＯｘ触媒１４の排ガス上流側に設けられこのＮＯｘ触媒１４に向けて炭化水素系還元剤を噴射可能な噴射ノズル１８と、噴射ノズル１８に前記還元剤を供給する還元剤供給手段２０とを備えたエンジン排ガスの触媒によるＮＯｘ低減装置の改良である。その特徴ある構成は、還元剤供給手段２０が液状の炭化水素２１を貯える貯蔵タンク２２と、このタンク２２に貯えられた炭化水素２１を液送管２３を介して圧送する圧送ポンプ２４と、この圧送された炭化水素２１をその炭素数を減少するように改質するリアクタ２６と、改質された炭化水素と改質されなかった炭化水素とを分離する炭化水素分離室２７と、改質された炭化水素を気送管２８を介して噴射ノズル１８に圧送するコンプレッサ２９とを備えたことにある。なお、このＮＯｘ低減装置に、ＮＯｘ触媒１４の排ガス上流側に設けられた温度センサ４６と、エンジン１０の負荷を検出する負荷センサ４４と、エンジン１０の回転速度を検出する回転センサ４２と、液送管２３に設けられた第１流量調整弁３１と、気送管２８に設けられた第２流量調整弁３２と、温度センサ４６、負荷センサ４４及び回転センサ４２の検出出力に基づいて圧送ポンプ２４、コンプレッサ２９、第１及び第２流量調整弁３１，３２を制御するコントローラ４０とを備えることが好ましい。更に、このＮＯｘ低減装置の炭化水素分離室２７の底部に改質されなかった液状の炭化水素を回収する回収タンク３３を設け、この回収タンク３３の液状の炭化水素を貯蔵タンク２２に戻す回収ポンプ３６を設けることが好ましい。

【０００５】

【作用】エンジン１０から排出されたガスは排気管１２を通り、噴射ノズル１８から供給された還元剤とともに触媒室１６に流入し、そこで排ガス中のＮＯｘはＮＯｘ触媒１４により還元処理されて無害のN_2に転化した後、大気に放出される。噴射ノズル１８から供給される還元剤は、質的にはリアクタ２６でクラッキングされ、分離室２７で精製分離された炭素数の減少した低分子量の炭化水素であるため、高い効率でＮＯｘをN_2に転化

する。また量的にはコントローラ４０が運転状態に応じて記憶される排ガス中のＮＯｘ含有量に見合った適量の還元剤を流量調整弁３１，３２等を制御して噴射ノズル１８から供給する。

【０００６】

【実施例】次に本発明の一実施例を図面に基づいて詳しく説明する。図１に示すように、ディーゼルエンジン１０の排気マニホルド１１には排気管１２が接続される。この排気管１２の途中にはエンジン側から還元剤噴射室１３と、ＮＯｘ触媒１４を収容する触媒室１６と、マフラー１７がこの順に設けられる。この例では、ＮＯｘ触媒１４は銅イオン交換ゼオライト（Ｃｕ－ＺＳＭ－５）により構成される。この銅イオン交換ゼオライトはゼオライトが含んでいるナトリウムイオンを銅イオンに置き換えた物質であって、ＮＯｘを炭化水素により還元する性質を有する。還元剤噴射室１３には噴射ノズル１８がＮＯｘ触媒１４に向けて設けられる。

【０００７】噴射ノズル１８に炭化水素系還元剤を供給する還元剤供給手段２０は、軽油２１を貯える貯蔵タンク２２と、この軽油２１を液送管２３を介して圧送する圧送ポンプ２４と、圧送された軽油の炭素数を減少するように改質するリアクタ２６と、改質された炭化水素と改質されなかった炭化水素とを分離する炭化水素分離室２７と、改質された炭化水素を気送管２８を介して噴射ノズル１８に圧送するコンプレッサ２９とにより構成される。この例では、コンプレッサ２９はモータ３０により駆動される。ポンプ２４の吐出側の液送管２３には第１流量調整弁３１が、またコンプレッサ２９の吐出側の気送管２８には第２流量調整弁３２がそれぞれ設けられる。これらの調整弁３１及び３２は電磁弁であって、調整弁３１及び３２にはタンク２２への戻り管３１ａ及び炭化水素分離室２７への戻り管３２ａがそれぞれ接続される。

【０００８】リアクタ２６はポンプ２４から圧送された炭素数１６の炭化水素を主成分とする軽油をクラッキングして主として炭素数３～１０の成分に改質する。この例では、リアクタ２６は粒状のゼオライトが充填されたカラム２６ａと、このカラム２６ａを加熱するヒータ２６ｂとを備える。炭化水素分離室２７は炭素数３～１０に改質された軽油とそれ以外の軽油とに分離するセパレータ２７ａと、周囲にヒータ２７ｂとを備える。カラム２６ａの入口は前記液送管２３に接続され、その出口は炭化水素分離室２７のセパレータ２７ａに向けられる。この分離室２７の底部には改質されなかった液状の炭化水素を回収する回収タンク３３が設けられ、分離室２７の頂部には改質され気化した炭化水素を吸引する前述した気送管２８と戻り管３２ａが接続される。この回収タンク３３と貯蔵タンク２２の間には回収管３４が接続され、回収管３４の途中には回収ポンプ３６が設けられる。

【０００９】第１及び第２流量調整弁３１及び３２、圧送ポンプ２４、コンプレッサ駆動用モータ３０、ヒータ２６ａ及び２７ｂ、及び回収ポンプ３６にはコントローラ４０の制御出力が接続される。このコントローラ４０の制御入力にはエンジン１０の回転速度を検出する回転センサ４２と、エンジンの負荷を検出する噴射ポンプ４３のロードレバー位置センサ４４と、触媒室１６のＮＯｘ触媒１４に流入する排気温度を検出する温度センサ４６とが接続される。コントローラ４０は図示しないメモリを備える。このメモリにはエンジンの回転速度、負荷及び排気温度に応じて噴射ノズル１８からＮＯｘ触媒１４に供給すべき炭化水素の量が予め記憶され、コントローラ４０はこの供給量に基づいて調整弁３１及び３２、圧送ポンプ２４、コンプレッサ駆動用モータ３０等を制御する。

【００１０】このような構成のＮＯｘ低減装置の動作を説明する。先ず、エンジン１０から排出されたガスは排気管１２を通り、還元剤噴射室１３に入り、ここで噴射ノズル１８により炭化水素系還元剤の供給を受ける。この還元剤の供給を受けた排ガスは触媒室１６に入り、ＮＯｘ触媒１４で排ガス中のＮＯｘを還元処理して無害のN_2に転化した後、大気に放出される。ここで噴射ノズル１８から噴射される還元剤は次の方法によりその品質が改良される。先ず、軽油が貯蔵タンク２２から圧送ポンプ２４によりリアクタ２６のカラム２６ａに送られ、４００～５００℃の温度でゼオライト触媒に接触して分解し、気化する。この軽油のクラッキングにより軽油が主として炭素数３～１０の低分子量の炭化水素に改質される。リアクタ２６で改質されなかった高分子量の炭化水素は炭化水素分離室２７のセパレータ２７ａで改質された炭化水素と分離される。この精製分離された改質還元剤はコンプレッサ２９で圧縮され噴射ノズル１８から噴射される。この炭素数の減少した炭化水素系還元剤は、ＮＯｘ触媒１４において、ＮＯｘをN_2に高い効率で転化する。

【００１１】また噴射ノズル１８から噴射される還元剤の量は次の方法により制御される。コントローラ４０がセンサ４２，４４，４６の検出出力により運転状態に応じてメモリに記憶される排ガス中のＮＯｘ含有量に見合った適量の還元剤を読出し、この還元剤の量に応じて流量調整弁３１，３２，圧送ポンプ２４，コンプレッサ駆動用モータ３０等を制御して適量の還元剤を噴射ノズル１８から供給する。具体的には、コントローラ４０はエンジン１０が低速回転域で軽負荷のときには噴射量を絞り、中高速回転域で中高負荷のときには噴射量を増大するように制御する。更に炭化水素分離室２７で改質されなかった高沸点の炭化水素系還元剤は回収タンク３３に回収され、回収ポンプ３６により貯蔵タンク２２に戻される。なお、上記例ではＮＯｘ触媒として銅イオン交換ゼオライトを挙げたが、他のゼオライト系、酸化物系の

触媒でもよい。また、リアクタにおいて軽油をゼオライト触媒を用いて接触分解する例を示したが、酸化チタン、シリカーアルミナ触媒等他の触媒を用いてもよい。

【００１２】

【発明の効果】以上述べたように、本発明によれば、炭化水素系還元剤が成分組成の点でＮＯｘのN_2への転化率が低い高沸点の炭化水素を含む軽油等であっても、リアクタで改質し、炭化水素分離室で特製分離して、有効な炭化水素系還元剤を選択的に取出し噴射ノズルから噴射するため、ＮＯｘ触媒上で排ガス中のＮＯｘが効率良くN_2に転化する。また、エンジンの運転状態に応じて還元剤の噴射量が制御され、結果として排ガス中のＮＯｘに応じて適量の還元剤を供給されるため、排ガスに含まれるＮＯｘを有効に低減することができる。

【図面の簡単な説明】

【図１】本発明の一実施例のＮＯｘ低減装置の構成図。

【符号の説明】

１０　エンジン
１２　排気管
１３　還元剤噴射室
＊１４　ＮＯｘ触媒
１６　触媒室
１８　噴射ノズル
２０　還元剤供給手段
２１　軽油（炭化水素系還元剤）
２２　貯蔵タンク
２３　液送管
２４　圧送ポンプ
２６　リアクタ
２７　炭化水素分離室
２８　気送管
２９　コンプレッサ
３１　第１流量調整弁
３２　第２流量調整弁
３３　回収タンク
３６　回収ポンプ
４０　コントローラ
４２　回転センサ
４４　負荷センサ
＊２０　４６　温度センサ

【図１】